habitation as possible. The charts show that the quantity of chlorine near the coast amounts to 6 parts in a million, at 4 miles away to 5 parts, at 20 miles to 3 parts, at 40 miles to 1 part, and at 100 miles to 0·4 part.

The fact that chlorine exists in rain water to a large extent near the sea coast was stated in the report on domestic water supply of the Rivers Pollution Commission in 1874. It was there shown that on the coast of Devonshire, where with south-west winds sea spray is blown over the land, the amount of chlorine varies from 1·20 to 2·10 parts in 100,000, and at the Land's End, with a strong south-west wind blowing, it amounts to as much as 21·8 parts. Inland the average quantity of chlorine diminishes to 0·39 part; increases to 0·99 part at Liverpool and 0·79 part at Newcastle.

Paper No. 151, by Mr. Marshall O. Leighton, deals with the field assay of water, and describes the methods which have for some time been used in connection with the investigations into the quality of water in various parts of the United States. The methods described relate, not to laboratory experiments, but to simple tests to ascertain the general character of the water by methods which can be carried out on the spot. These field determinations give the turbidity and colour of the water, the presence of chlorine, carbonates, calcium, and iron, and the amount of hardness; also the amount of suspended matter. The former are more particularly required in water for domestic supply, and the latter for that used for irrigation purposes. The amount of gradient to be given to a canal for conveying water for irrigation is governed to a great extent by the solid matter in suspension, and this also affects the capacity of the storage reservoirs. The method for determining turbidity, accompanied by an illustration of the gauge used for this purpose, was given in NATURE of January 7, 1904. A description and illustration of the Geological Survey field case is given in the paper.

Paper No. 143, by Mr. J. H. Quinton, details the experiments made under the direction of the Reclamation Department on steel concrete pipes for the purpose of determining the durability and permanence of these structures in connection with the supply of water for irrigation purposes. The pipes experimented on were 5 feet in diameter, 20 feet long, and 6 inches thick, of concrete, enclosing an armour of steel rods sufficient to resist a head of 150 feet of water with a factor of safety of 4. The experiments showed the difficulty, even with the closest attention to the construction, of making pipes of this kind that would stand a head of 100 feet.

Paper No. 150, by Mr. Robert E. Horton, gives the results of an investigation of the theory of weir measurements, and the discharge over different forms of weirs. The various coefficients of Bazin, Fteley, Stearns, and Hamilton Smith are analysed. A further description is given of the experiments performed at the Cornell University laboratory, where a closely regulated volume of water was passed over weirs of different forms placed across an experimental canal, and the results obtained compared with the different formulæ for obtaining the discharge. Tables are also given for calculating the discharge over weirs.

GREENWICH OBSERVATIONS.[1]

IN the introduction to the first work mentioned below, an opinion is expressed that the revision of an old catalogue must always be a source of anxiety to those who advise and undertake the revision, and that only the final result can justify the expenditure of the time and labour. Those who are responsible for this work need be under no apprehension that their efforts have been misspent. It would rather seem that in this case they have fulfilled a necessary duty, and discharged an honoured trust. It has always seemed to the writer that the ancient authorities at Greenwich were a little wanting in patriotism and enterprise in entrusting to a foreigner, however eminent, the reduction and discussion of Bradley's observations. Groombridge's observations, in a sense, may not be so completely a national possession as those of Bradley, but certainly it is not unfitting that at the Royal Observatory, almost within the shadow of which Groombridge erected his transit circle, his observations should be examined and discussed.

There are several circumstances which tend to give distinction to Groombridge's work. At the beginning of the last century his instrumental equipment was equal to, if not more powerful than, that of any other observer in Europe. The fact that, as an amateur, he gave his time and leisure to the repetition of the same mechanical performance shows that he was a lover of order and accuracy. Pond, the Astronomer Royal, whatever his failings may have been, appreciated the necessity for certainty and accuracy, and he must have impressed these qualities upon Groombridge. Further, the lapse of time, that factor which has increased the value of so much astronomical work and enhanced the reputation of so many worthies, has fought on the side of the retired West Indian merchant.

The method to be pursued in the reductions, how far the observations are to be treated as independent, how far they are to be regarded as differential, are points which must be left to the decision of the computers. They must accept the entire responsibility, since the knowledge and experience is theirs. In this case it is not impossible but that they have had the assistance of tradition. The interesting remarks of Colonel Colby and Dr. Firminger quoted by the revisers, probably do not exhaust the information at their disposal. It would be an impertinence for anyone who has not even seen the originals to offer any criticism on the methods employed by those who have gained familiarity and experience by long contact with Groombridge's figures. These methods are described with clearness and in sufficient detail, but the revisers must know so much more than they can set down.

The result is to obtain a catalogue for the equinox of 1810 of 4239 stars. The number in the original Groombridge catalogue was 4243, but of these nine have been rejected on various grounds, and five have been added as separate stars. The places of a few more stars have been considered discordant, and have not been used in the subsequent discussion of proper motion. The accuracy of the catalogue and the care of the observer can both be estimated in some measure from the fact that a discrepancy of four seconds of arc in either right ascension or polar distance has been considered a proper limit to warrant the exclusion of the observation. The number excluded is 75 in right ascension and 214 in polar distance, slightly more than 1 per cent. of the total number of observations.

The peculiar value of this catalogue lies in the fact that its epoch is 1810. Therefore, by comparison with modern observations, it offers the means for a new determination of the precessional constant, while the new proper motions which it makes available should give greater certainty to researches into the amount and direction of the solar motion. The length of time elapsed since Groombridge's day is not much less than that available in the case of Auwers-Bradley, and the accuracy of the observations would seem to be of the same order; but Bradley's optical means were smaller, and the average of his stars considerably brighter. Groombridge's stars include many of the ninth magnitude, and fill a gap between those to which Bradley's observations refer and the results that will be derived from photography. On the other hand, Bradley's stars were better distributed over the whole sky. Groombridge limited his observations to the circumpolar regions. Against this drawback, as against many others, the Greenwich authorities have struggled with apparent success, and a few of their final results may be given.

We have, in the first place, the proper motions of more than four thousand stars determined by comparison of places at intervals of approximately ninety years. These proper motions have been derived for the most part by a

[1] "New Reduction of Groombridge's Circumpolar Catalogue for the Epoch 1810–0." By F. W. Dyson, F.R.S., and W. G. Thackeray. Under the direction of Sir William H. M. Christie, K.C.B., F.R.S., Astronomer-Royal. (Published by order of the Board of Admiralty in obedience to His Majesty's command. Edinburgh: Neill and Co., Ltd., 1905.) Price 24s.

"Telegraphic Determinations of Longitude made in the Years 1888–1902, under the direction of Sir W. H. M. Christie, K.C.B., F.R.S., Astronomer-Royal. (Published by the Board of Admiralty in obedience to His Majesty's command. Edinburgh: Neill and Co., Ltd., 1906.) Price 15s.

simple comparison of positions at the extreme limits of time. It is not made clear why observations at intermediate dates, such as those of the Radcliffe Observatory, have not been used. The plan adopted seems the more strange, since the precessional variation has been applied and a comparison has been instituted. Considering the important part these proper motions were to play in the subsequent discussion, it would seem that too much care could not be exercised in their determination. These proper motions have been arranged in tables according to their amount, or the magnitude of the stars, or the character of spectrum, and, indeed, in every way that ingenuity could suggest as likely to be useful. This method of distribution cannot but be of essential service to those who wish to make further use of the material.

Next we have a determination of the precessional constants. The final result may not possess more than an academic interest, but the research is thorough and valuable. It would serve no useful purpose to enter into details, since those who are interested in such recondite questions must refer to the original sources for information, but the numerical results may be quoted, since they differ from Newcomb's values by a greater amount than would have been anticipated. For the centennial values of m and n we have :—

	m	n
Newcomb	4607″·11 ...	2005″·11
Dyson and Thackeray ...	4607″·57 ...	2005″·31

Another result which follows incidentally from the method of discussion is to show that, so far as this material is available, there is no reason to suspect any rotation of the brighter stars, as a whole, relatively to the fainter stars.

Lastly, the authors assign a direction to the solar motion, or rather many directions, for the material is discussed in many ways, all interesting. Here, again, we must content ourselves with the final result, which places the apex of the sun's motion in right ascension 275° and north declination 37°, referred, presumably, to the equinox of 1850.

In tendering our congratulations to Messrs. Dyson and Thackeray, and all who have been engaged in this work, we cannot help remarking that, as in the past, the Royal Observatory has distinguished itself by its energy in laboriously piling up observations, so in this instance, it demonstrates equally happily its power to make the accumulated material available for the advance of philosophical astronomy.

The title of the second book reminds us how loyally the Greenwich Observatory has served the purposes of its foundation. To determine, or to supply the means for determining, the longitude has constantly figured in its programme of work. The times have altered, the conditions of the problem have changed, and, above all, accuracy has increased, but, steadfast to its original design, the Royal Observatory has always been willing to assist in such inquiries, whether in the interests of navigation or for the purposes of geodesy. The Paris meridian seems to have been a constant source of anxiety to Greenwich, and the present volume gives the history of no less than three attempts to grapple with the difficulty. The two earlier results, 9m. 20·85s. and 9m. 20·79s. west of Greenwich, seem fairly accordant to the lay mind, but since they both differed in the same direction from the results of the French observers, the small discrepancy led to a third attempt in 1902, from which it appeared that Paris was west of Greenwich 9m. 20·932s., with a probable error of only 0·006s. Since this probable error is equivalent to about the length of an ordinary writing table, it would seem to possess the necessary accuracy, and the problem of the distance between the meridians of Greenwich and Paris may be considered as laid aside for some time to come. The remaining portion of the book is concerned with the longitudes of Montreal, Waterville, and Canso, and of stations incidentally connected with the scheme of operations. The result is to place Montreal in west longitude 4h. 54m. 18·62s., with an uncertainty of about 20 feet. Doubtless the day will come when this error will be felt to be intolerable, but if a demand is made for a fresh inquiry, we may be sure that the best traditions of Greenwich will respond to the appeal. W. E. P.

ANTI-TYPHOID VACCINE.

A MEMOIR "On the Standardisation of Anti-typhoid Vaccine," by Captain George Lamb and Captain W. B. C. Forster, has just appeared (Scientific Memoirs of the Government of India, No. 21. Calcutta: The Government Printing Office, 1906. Pp. 15. Price 7*d.*). After reviewing the various methods which have been proposed for the standardisation of Wright's anti-typhoid vaccine, Captains Lamb and Forster come to the conclusion that the virulence of the organisms used in the preparation of the vaccines must be taken into account. Since it appears that virulence is in direct proportion to the number, or avidity for immune body, of the receptors, an estimation of these latter in any vaccine will take cognisance of the virulence of the organism from which it was prepared. Admitting this as a basis, the method of standardisation suggested by Captains Lamb and Forster is to estimate what dilution of the various vaccines when mixed in equal parts with serum is able to remove completely the bactericidal power of that serum; in other words, to determine in what dilution of vaccine the receptors completely neutralise the amboceptor content of the serum. This is carried out by preparing a number of different dilutions of the vaccine, which are each mixed with the same amount (100 c.cm.) of fresh goat serum, and left in contact for an hour at 37° C. At the end of this period a small quantum of living typhoid culture is added to each tube, the several tubes are incubated for about twenty-four hours, and then sterile broth is added to each tube in order to ascertain whether the bacilli have been killed or no, and in this way various vaccines may be compared. The memoir must be consulted for the details of the method. R. T. HEWLETT.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The thirteenth "Robert Boyle" lecture of the Junior Scientific Club will be delivered by Prof. J. H. Poynting, F.R.S., on Wednesday, May 30, upon the subject of "The Pressure of Light."

Mr. J. S. C. Douglas, Christ Church, has been elected to the Radcliffe travelling fellowship for 1906.

Prof. Ritchie, fellow of New College, has been nominated as an examiner in preventive medicine for 1906, 1907, and 1908.

The 284th meeting of the Junior Scientific Club was held on May 16, when Mr. P. W. Robertson read a paper on "A New Method of Estimating Quinine," and Prof. E. G. Hill one on "Chemistry in India."

CAMBRIDGE.—The museums and lecture rooms syndicate has reported that the chemical laboratory of Gonville and Caius College will be closed at the end of the academic year 1906–7. It will therefore be necessary to provide further accommodation in the University for the students who have hitherto found places in the chemical laboratory. The museums and lecture rooms syndicate recommends that a site in the museums' grounds contiguous to the buildings of medicine should be set apart for this purpose. It is also recommended that the proposed extension of the Cavendish Laboratory should take place on a site with a frontage to Free School Lane to the north of the existing building. Lord Rayleigh's gift of 5000*l.* of the Nobel prize will, it is hoped, enable this building shortly to be begun.

The Vice-Chancellor has been authorised to convey to the Worshipful Company of Goldsmiths the thanks of the University for its munificent gift of 5000*l.*, to be applied to the present needs of the University library.

The well-known authority on coral reefs and oceanography, Mr. J. Stanley Gardiner, has been nominated by the master and fellows of Gonville and Caius College to be pro-proctor for the ensuing year.

Dr. Bonney will lecture at 5 p.m. on Thursday, May 31, in the Sedgwick Museum, on "Volcanoes and Man's Experience of them."

Steps are being taken for the provision of a permanent endowment to place the Balfour library in a secure position. The library owes its origin to the generosity of the family of the late Prof. F. M. Balfour, who after his death in 1882 presented his scientific books to the University for the